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A REVIEW ON AGRO-VOLTAGE TECHNOLOGY- A SOLUTION TO THE FARMERS IN INDIA

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Abstract: Anxieties and loan relinquishments have fetched the finance of farming in attention. Most of the debate is related to minimum support price, farmer's average wages and loan repayment ability. But one of the main problems faced by the farmers is electric supply. Agriculture voltage technology can upsurge the income of farmers by generation of electricity and growing cash crops on the same land. This review paper discusses about different types of agro-voltaics, the KUSUM scheme and its different components in detail which is launched by the Central Government of India and how it can help the farmers with better profits.

***Keywords*: Agriculture voltage technology, KUSUM scheme, solar arrays, stilled solar arrays, green house solar arrays.**

1. Introduction

Agro-voltaic or agro-photovoltaic is the direct usage of land for solar energy and agriculture. The co-occurrence of solar panels and crops means dividing the light amongst these twotypes of production, so the plan objectives of the agro- voltaic necessitate trade-offs such as improving harvests, crop value and energy production. Currently, relevant practices and laws regarding solar energy production differ from country to country. In Europe and Asia, where the idea was first introduced, the term "agro-voltaic" is used to mention to distinct dual-use of technology. Usually the land is located on the roof of a greenhouse with installed agricultural equipment or solar panels. The shadows created by these systems can decrease the yield of some crops, but these losses can be compensated for by the energy produced. Although many pilot plants have been installed by administrations around the world, these systems are not known to be commercially feasible outside of China and Japan. The greatest significant factor in the profitability of agro-voltaic is the cost of installing solar modules. It is expected that the development of this project in Germany, the subsidy given for such projects by a bit extra than 300% can mark the scheme profitable for stockholders andtherefore can be a portion of the upcoming combination of electricity generation. In 2019, several authors began to use the term agro-voltaic ina broader sense to encompass all agricultural activity in the existing traditional solar system. For example, sheep can grazeamongst prevailing solar panels deprived of any alterations. And in the United States, small scale schemes that abode hives on the edge of existing solar arrays are called agricultural power grids. Similarly, agro-voltaic is widely accepted by some as it involves installing solar panels only on the rooftops of a barn or cattle shed.

2. Methods

There are three fundamental kinds of agrivoltaics which mightbe being actively researched: sun arrays with area among for plants, stilted sun arrays above plants, and green house sun arrays. All 3 structures have numerous variables used to maximize sun electricity absorbed in each of the panels. The major variable taken into consideration for agrivoltaic structures is the lean attitude of the sun panels. Other variables taken under consideration for selecting the area of the agrivoltaic device are the plants chosen, panel heights, sun irradiance and weather of the area.
Some of the system designs are as follows:

- Orientation of sun panels within side the south for constant or east-west panels forpanels rotating on an axis.
- Spacing among sun panels for enough mild transmission to floor crops.
- Elevation of the assisting shape of the sun panels to homogenize the quantities ofradiation at the floor.

3. About KUSUM Scheme

Fig 1: Features of KUSUM scheme

The scheme objectives to offer more earnings to farmers, via way of means of giving them a choice to promote extra energyto the grid via solar parks installed on their agricultural lands. The Government of India has launched New Scheme for farmers with the following three components:

S.No	Component-A	Component-B	Component-C
1.	Decentralized ground/slit mounted grid connected solar or other renewable energy based power plants with a capacity of 10000MW.	17.50 lakh solar-powered agriculture pumps with a capacity of up to 7.5 HP would be installed.	Solarization of 10 lakh solar-powered agricultural pumps with capacities of up to 7.5 horsepower that are connected to the grid.
2.	The generated electricity will be purchased by the DISCOMs at Feed-in Tariffs set by the SERC.	Individual farms will be helped, and the scheme allows for solar PV capacity in kW equivalent to pump capacity in HP.	DISCOM will purchase the extra energy.

Table 1: Component of KUSUM Scheme

This scheme will be called as Pradhan Mantri Kisan UriaSuraksha evem Utthan Mahabhiyan (PM KUSUM) scheme.
Components A and C will be used in an experimental mode for 1000 MW and one lakh grid-connected farm pumps, respectively, while Component-B will be used in its entirety with a total Central Government contribution of Rs. 19,036.5 crore.

Component	**Revised target**	**Solar capacity (GW)**	**CFA**	**Service charges**	**Total**
A	10000 MW	10.0	3300	25	3325
B	20lakh Pumps	9.6	15600	312	15912
C	15lakh Pumps	11.2	14508	390	14798

Total		**30.8**	**33408**	**627**	**34035**

Table 2: Component wise solar capacity and financial supportgiven by the Central Government

Following the successful completion of the experimental project for Components A and C, a similar project would be mounted with necessary changes based on the lessons learned from the experimental stage, with a total Central Government assistance of Rs 15,385.5 crore. With a total Central Financial Support of 34,422 crore, all three components of the project aim to add solar capacity of 25,750 MW by 2022.

1.Implementation Mechanism

These guiding principles have been framed to deliver comprehensive application for the framework of the scheme.

I. Component A: Setting up of 10,000 MW of Decentralized Ground/Stilt Mounted Grid Connected Solar or other Renewable Energy based Power Plants

Individual farmers, groups of farmers, cooperatives, panchayats, Farmer Producer Organizations (FPO)/Water User Associations (WUA) would set up solar or other renewable energy based power plants (REPP) with capacities ranging from 500 kW to 2 MW under this component (RPG). In some situations, states/DISCOMs may approve the construction of solar or other renewable energy-based power plants with a capacity of less than 500 kW. To prevent excessive sub-transmission line costs and transmission losses, the REPP will be installed within a five-kilometer radius of the sub-stations.

The distribution companies (DISCOMs) will inform sub-station-by-sub-station surplus capacity that can be fed into the grid from such renewable energy facilities, and will accept applications from interested parties to build the renewable energy plants. DISCOMs will acquire the renewable energy generated at a pre-determined levelised pricing.

Fig 2: 105 kW developed by ICAR-CENTRAL ARID ZONE RESEARCH INSTITUTE, JODHPUR under Component 1 of KUSUM scheme

II. Component B: Installation of 17.50 Lakh Stand- alone Solar Pumps

Individual farmers would be assisted to build standalone solar agriculture pumps with a capacity of up to 7.5 HP to replace current diesel agriculture pumps / irrigation systems in off-grid locations where grid supply is not available under this component. This system also allows for the installation of new pumps, with the exception of dark zone locations. Pumps with a capacity more than 7.5 HP may be permitted, however the CFA will be limited to that of a 7.5 HP pump. This component will also address Water User Associations and community/cluster based irrigation systems. In addition, when the grid reaches the off-grid area, the stand-alone Solar Agriculture Pumps can be connected to the grid to supply surplus electricity, based on grid capacity. DISCOMs can buy this surplus power from farmers at a tariff set by the State/SERC.

Fig 3: Agricultural Solar Pump under Component 2 ofKUSUM scheme

III. Component C: Solarisation of 10 Lakh Grid Connected Agriculture Pumps

Individual farmers with grid-connected agriculture pumps will be aided in their efforts to solarize their pumps under this component. The scheme allows for solar PV capacity of up to two times the pump's kW capacity. The state, on the other hand, may stipulate a lower solar PV capacity in kW, which must not be less than the pump capacity in HP in any event. It will not be less than 2 kW for a 2-HP pump, for example. The farmer will be able to use the solar energy generated to suit his or her irrigation demands, with any extra solar energy supplied to DISCOMs. This component will also include water user associations and community/cluster-based irrigation systems. Small and marginal farmers, on the other hand, would be given first attention. Farmers that use Micro irrigation systems, are covered by Micro irrigation schemes, or opt for Micro irrigation systems will be given preference in order to reduce water usage for irrigation.

Fig 4: Implementation of Component C of PM KUSUMScheme

The implementing agencies will be DISCOMs/GENCO/any other Department selected by the State Government. All agencies executing the system, including the approved State Implementing Agencies, will receive 2% of the eligible CFA as total service charges. In the case of centralised tendering, the central agency will get a percentage/fixed amount of service charges (determined by MNRE). MNRE may also keep a portion of the service charge for centralised IEC efforts across the country.

Farmers' excess power will be purchased by DISCOMs at a rate determined by the appropriate State/SERC. Solarised feeders will be given "must-run" status by the DISCOMs, who will keep them "on" during daylight hours.

Conclusion

Agricultural land is the greatest fit for solar farms in relations with effectiveness: the greatest income/ power can be produced by the solar engineering by substituting agricultural land through fields of solar panels, as contrasting to using infertile land. This is mainly because photovoltaic systems in overall reduction in efficiency at higher temperatures, and farmland has normally been produced in zones with wetness- the cooling properties of vapour pressure is an essential factor in growing panel productivity. It is therefore predictable that the upcoming solar power generation will upsurge competitionfor farmland in the nearby future.

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